UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte TINGHAO F. WANG

Appeal No. 2006-0293
Application No. 10/071,809

ON BRIEF

Before OWENS, WALTZ and TIMM, Administrative Patent Judges.
WALTZ, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal from the primary examiner's final rejection of claims 1, 3 through 12, 14, 15, 21 through 23, 25 and 27, which are the only claims pending in this application. We have jurisdiction pursuant to 35 U.S.C. § 134.

According to appellant, the invention is directed to a method of etching a metal silicide layer while fabricating an integrated circuit using a chlorine/oxygen gas environment at a pressure of approximately 2 to 40 mili-Torr and an oxygen

concentration of greater than or equal to 25% by volume (Brief, page 2).

Representative independent claim 1 is reproduced below:

1. A method comprising, etching a metal silicide layer during fabrication of an integrated circuit in a $Cl_2/0_2$ environment having an 0_2 concentration of greater than or equal to 25% by volume,

wherein the $Cl_2/0_2$, environment is provided at a pressure of approximately 2-40 mili-Torr, and wherein the etching is a metal silicide etch that is selective to poly-silicon with a ratio of etch rates of at least 30.

The examiner has relied upon the following references as evidence of obviousness:

Tsai 5,880,033 Mar. 09, 1999

Langley et al. (Langley), "One-Chamber Polycide Sandwich Etching," *Semiconductor International,* pp. 95-97, October 1989.

Appellant relies upon the following reference as evidence of non-obviousness:

Nojiri et al. (Nojiri), *J. Vac. Sci. Technol.*, B14(3), May/June 1996, pp. 1791-1795.

Claims 1, 3-12, 14, 15, 21 and 27 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Tsai (Answer, page 3). Claims 22, 23 and 25 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Tsai in view of Langley (Answer, page 4). We *reverse* both rejections on appeal essentially for the reasons

stated in the Brief and those reasons set forth below. Pursuant to our authority under 37 CFR § 41.50(a)(1)(2004), we also *remand* this application to the examiner for action consistent with our remarks below.

OPINION

A. The Rejections on Appeal

The examiner finds that Tsai discloses a method of etching metal silicide using chlorine and oxygen under the same pressure and power ranges as disclosed and claimed by appellant, with flow rates of 20-800 sccm of chlorine and 1-50 sccm for oxygen (Answer, page 3). The examiner recognizes that Tsai does not disclose the claimed oxygen concentration of greater than or equal to 25% by volume (*id.*). However, the examiner finds that Tsai teaches that a high concentration of oxygen is desirable and etches the metal silicide at a much greater rate (Answer, sentence bridging pages 3-4). The examiner also finds that Tsai teaches that the power ratio may be optimized (Answer, page 4). From these findings, the examiner concludes that it would have been obvious to one of ordinary skill in this art to determine the optimum parameters through routine experimentation to etch the metal silicide at a high rate and selectivity with respect to the underlying polysilicon layer (*id.*). We disagree.

As correctly argued by appellant (Brief, page 4, footnote 2, and page 9, footnote 6), and apparently overlooked by the examiner (Answer, page 5), the disclosure of Tsai mistakenly recites that the etching selectivity "increases" with increasing flow rates of oxygen while in fact the data of Tsai establish that etching selectivity decreases with higher flow rates of oxygen since the polysilicon etch rate increases with increasing flow rates of oxygen (compare Tsai, col. 7, ll. 63-66, with Figure 4, and also compare Tsai, col. 8, ll. 5-7, with Figure 5). It is clear from Figure 5 of Tsai that the selectivity decreases when the oxygen flow rate is increased from 0 to 10 sccm, although the selectivity increases at a constant oxygen flow rate when the flow rate of nitrogen increases. It is also clear from Figure 4 of Tsai that, at any nitrogen flow rate, the polysilicon etching rate undesirably increases with increasing oxygen flow rates from 0 to 10 sccm.

Additionally, as correctly argued by appellant (Brief, page 6), Tsai teaches away from the use of "excessively high" flow rates of oxygen (Tsai, col. 7, ll. 15-20). Furthermore, Tsai teaches preferred volume flow ratios where the maximum volume flow of oxygen could be 13.89% (col. 8, ll. 17-22, where the oxygen/nitrogen ratio is 5:1 and the chlorine to oxygen+nitrogen

ratio is 5:1). Finally, Tsai exemplifies about a 3% by volume oxygen plasma gas to achieve a selectivity of about 4-5 (col. 9, ll. 23-45).

"Under the proper legal standard, a reference will teach away when it suggests that the developments flowing from its disclosures are unlikely to produce the objective of the applicant's invention. *In re Gurley,* 27 F.3d 551, 553 (Fed. Cir. 1994)." *Syntex v. Apotex,* 407 F.3d 1371, 1380, 74 USPQ2d 1823, 1830 (Fed. Cir. 2005). General skepticism of those in the art is relevant and persuasive evidence of non-obviousness. *See Gillette Co. v. S.C. Johnson & Son, Inc.,* 919 F.2d 720, 726, 16 USPQ2d 1923, 1929 (Fed. Cir. 1990). The disclosures of Tsai, as discussed above and in the Brief, certainly suggests developments that are unlikely to produce the objective of appellant's invention, namely the ratio of etch rates of at least 30. Furthermore, the examiner has not commented on the Nojiri article cited by appellant (Brief, page 2), which teaches that the etch rate of tungsten silicide increases up to an oxygen concentration of 10% but etching suddenly stops when the oxygen concentration exceeds 25% (page 1792, left column and Figure 2).

For the foregoing reasons and those stated in the Brief, we determine that the examiner has failed to establish a prima facie

case of obviousness with respect to the reference evidence. Therefore we cannot sustain the examiner's rejection of claims 1, 3-12, 14, 15, 21 and 27 under section 103(a) over Tsai.

With regard to the rejection of claims 22, 23 and 25 (Answer, page 4), the examiner applies Langley to show use of a "breakthrough" etch. Therefore, Langley fails to remedy the deficiencies in the rejection discussed above. Accordingly, this rejection is also reversed.

B. The Remand

Pursuant to our authority under 37 CFR § 41.50(a)(1)(2004), we remand this application to the jurisdiction of the examiner for actions consistent with our remarks below.

The examiner and appellant should consider the patentability of the claimed subject matter in view of the requirements of 35 U.S.C. § 112, first paragraph, regarding the scope of the enabling disclosure. Appellant is claiming a method that is the same or substantially the same as disclosed by Nojiri, as discussed above. Nojiri discloses an etching method for the same tungsten silicide/polysilicon layers as here claimed, under the same pressure and other reaction parameters, and tests the process at oxygen concentrations of 25% as per appellant's claim 1 (pages 1791-1792). However, as noted by appellant

(specification, page 7, ll. 15-17), appellant discloses and claims a selectivity ratio of at least 30 while Nojiri discloses that the "etching suddenly stops" at an oxygen concentration of 25% (page 1792, left column). The only difference between the method of Nojiri and appellant's *disclosure* is the teaching of using a "breakthrough" etch using carbon tetrafluoride (specification, page 7, ll. 17-20). Accordingly, the enabling disclosure appears to be lacking any teachings of how to achieve the desired result as compared to the undesired results of the prior art method, absent the use of a breakthrough etch using carbon tetrafluoride. This "breakthrough" etch is only specifically claimed in claim 23 on appeal. Therefore it would appear that the remaining claimed subject matter is not supported by an enabling disclosure, since Nojiri is evidence that the claimed objective cannot be met by following the process as claimed. *See In re Mayhew,* 527 F.2d 1229, 1233, 188 USPQ 356, 358 (CCPA 1976).

Accordingly, we remand this application to the jurisdiction of the examiner for consideration of the issue raised above.

This application, by virtue of its "special" status, requires an immediate action, *MPEP* § 708.01 (D).

REVERSED & REMANDED

TERRY J. OWENS)
Administrative Patent Judge)
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THOMAS A. WALTZ) BOARD OF PATENT
Administrative Patent Judge) APPEALS
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